



Future Potential RETI Work by Black & Veatch

Black & Veatch

Ryan Pletka

Stakeholder Steering Committee Meeting

July 29, 2009

Types of Changes

- CREZ and Technology Updates
- Extended Analysis of WECC Resources
- Economic Model Update

CREZ and Technology Updates

- Solar
 - Update site-specific solar project characteristics for large solar projects that have been moved
 - Re-evaluate the assumptions for wet/dry cooling at solar thermal projects
 - Update solar profiles to correct truncation issue. Likely to reduce solar thermal CFs by ~8% (e.g. from 24% to 22%)
 - Revisit solar technology assumptions (storage for solar thermal, thin film for PV)
 - Re-evaluate cost assumptions for solar thermal and solar PV projects

CREZ and Technology Updates

- Geothermal
 - Consider dry-cooling impacts on geothermal output profiles (current assumption is flat)
 - Update geothermal project cost
- Wind
 - Reassess Palm Springs wind resources
 - Reassess Fairmount wind resources
 - Review 12x24 typical output profiles against WREZ and new data
- Reassess need / definitions for sub-CREZs
- Update pre-ID project information

Extended Analysis of WECC Resources

- Western Renewable Energy Zones

WREZ QRA Hub Map

"Hubs" are regional, geographic concentrations of renewable resource potential in the Western Hemisphere for purposes of evaluating renewable transportation fuel value as based on potential to provide amount of electricity (or thermal capacity for the transportation of the fuel) produced over the course of the year under the appropriate plan to the WREZ. Hubs are defined by a number of criteria: environmental and technical factors and they account for remaining resource potential to account for resource development constraints. In some instances, the energy generating potential of a hub is not defined to account for future environmental capabilities identified by state climate agencies. Hubs do not represent physical boundaries, but do not indicate actual potential boundaries either. Thus, the location of potential renewable transportation fuel, not a renewable development potential in other areas where it is not.

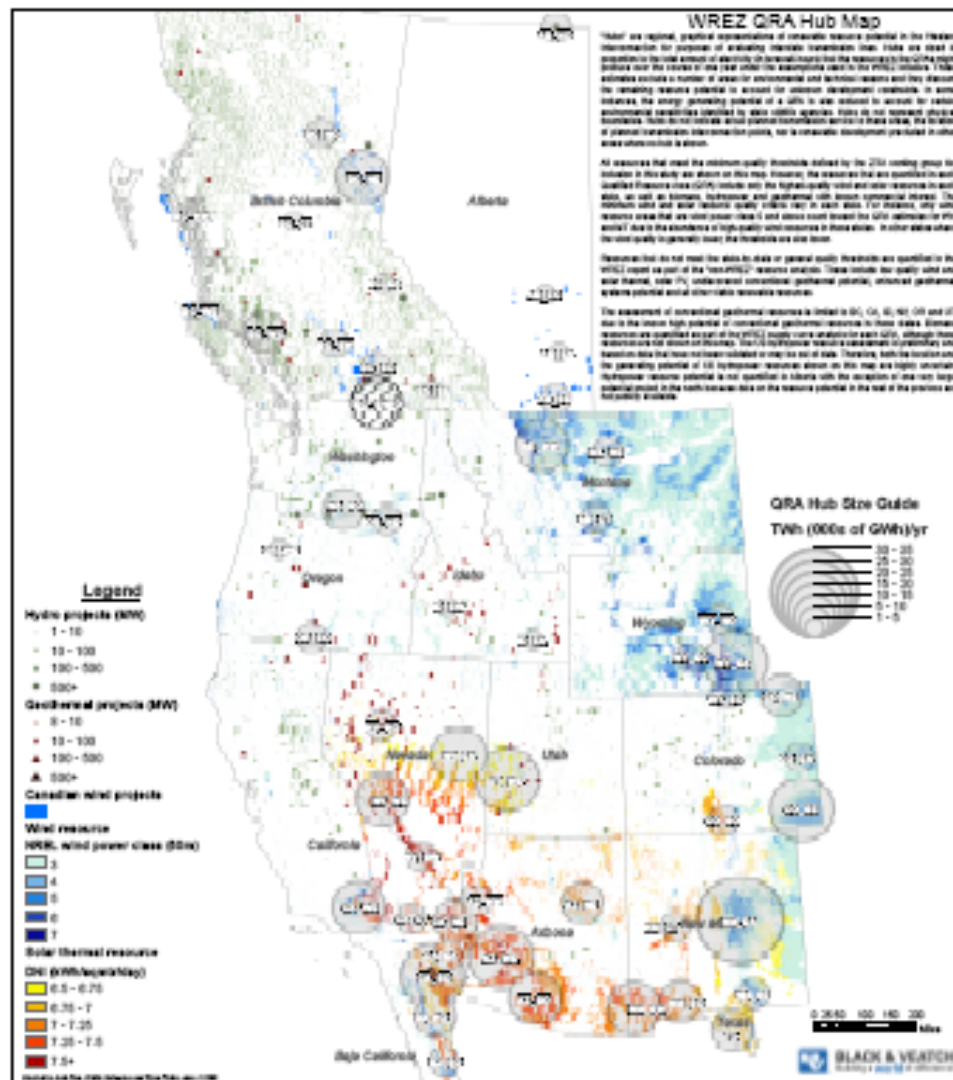
All resources that meet the minimum quality thresholds defined by the 2015 existing group for inclusion in this study are shown on this map. However, the resources that are qualified in high quality resources are shown only the highest quality wind and solar resources in each state, as well as biomass, hydroelectric and geothermal (see below) potential. The minimum value for each resource quality criteria is: 1) wind, 1000 m/s; 2) solar, 1000 m/s; 3) biomass, 1000 m/s; 4) hydroelectric, 1000 m/s; 5) geothermal, 1000 m/s. In other words, when the minimum quality threshold is met, the resources are also shown.

Resources that do not meet the minimum quality thresholds are qualified in the WREZ report as part of the "low quality" resources. These include the quality wind and solar thermal, solar PV, hydroelectric, conventional geothermal potential, biomass, geothermal, biomass potential and other renewable resources.

The assessment of conventional geothermal resources is based on 100, 200, 400, 600, 800 and 1000 m/s in the lowest high potential in conventional geothermal resources in these states. Biomass resources are qualified except in the WREZ report as part of the "low quality" resources. These resources are not shown on this map. The WREZ report includes a table of biomass resources and a table of biomass resources by state. The biomass resources are shown in the WREZ report as part of the "low quality" resources. The biomass resources are shown in the WREZ report as part of the "low quality" resources. The biomass resources are shown in the WREZ report as part of the "low quality" resources.

QRA Hub Size Guide

TWh (000s of GWh)/yr



Notes on Each State/Province

Alaska: Hubs and resource concentrations are defined on a smaller scale than those in the continental United States. Alaska's renewable resource potential is high, particularly in the north. However, the potential is not defined to suggest that renewable development should occur there. Alaska's renewable resource potential is high, particularly in the north. However, the potential is not defined to suggest that renewable development should occur there. Alaska's renewable resource potential is high, particularly in the north. However, the potential is not defined to suggest that renewable development should occur there.

Arizona: Hubs and resource concentrations are defined on a smaller scale than those in the continental United States. Arizona's renewable resource potential is high, particularly in the south. However, the potential is not defined to suggest that renewable development should occur there. Arizona's renewable resource potential is high, particularly in the south. However, the potential is not defined to suggest that renewable development should occur there.

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Nevada: Hubs and resource concentrations are defined on a smaller scale than those in the continental United States. Nevada's renewable resource potential is high, particularly in the north. However, the potential is not defined to suggest that renewable development should occur there. Nevada's renewable resource potential is high, particularly in the north. However, the potential is not defined to suggest that renewable development should occur there.

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North Dakota: Hubs and resource concentrations are defined on a smaller scale than those in the continental United States. North Dakota's renewable resource potential is high, particularly in the north. However, the potential is not defined to suggest that renewable development should occur there. North Dakota's renewable resource potential is high, particularly in the north. However, the potential is not defined to suggest that renewable development should occur there.

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Utah: Hubs and resource concentrations are defined on a smaller scale than those in the continental United States. Utah's renewable resource potential is high, particularly in the north. However, the potential is not defined to suggest that renewable development should occur there. Utah's renewable resource potential is high, particularly in the north. However, the potential is not defined to suggest that renewable development should occur there.

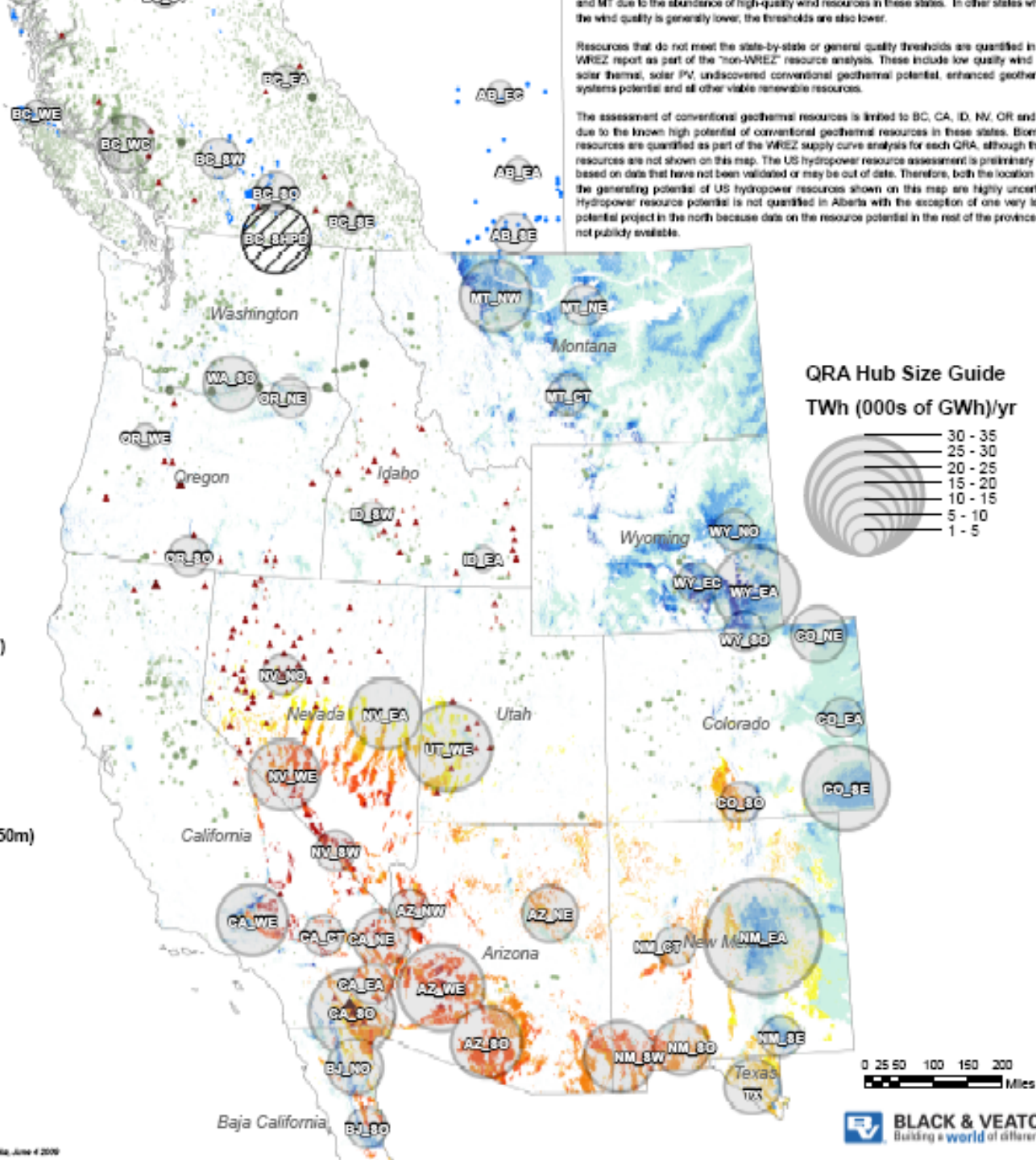
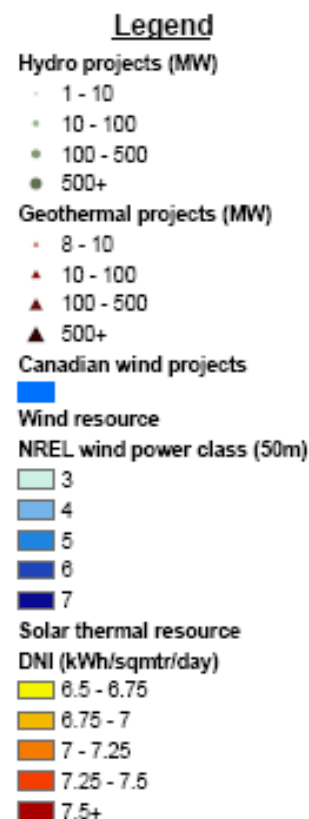
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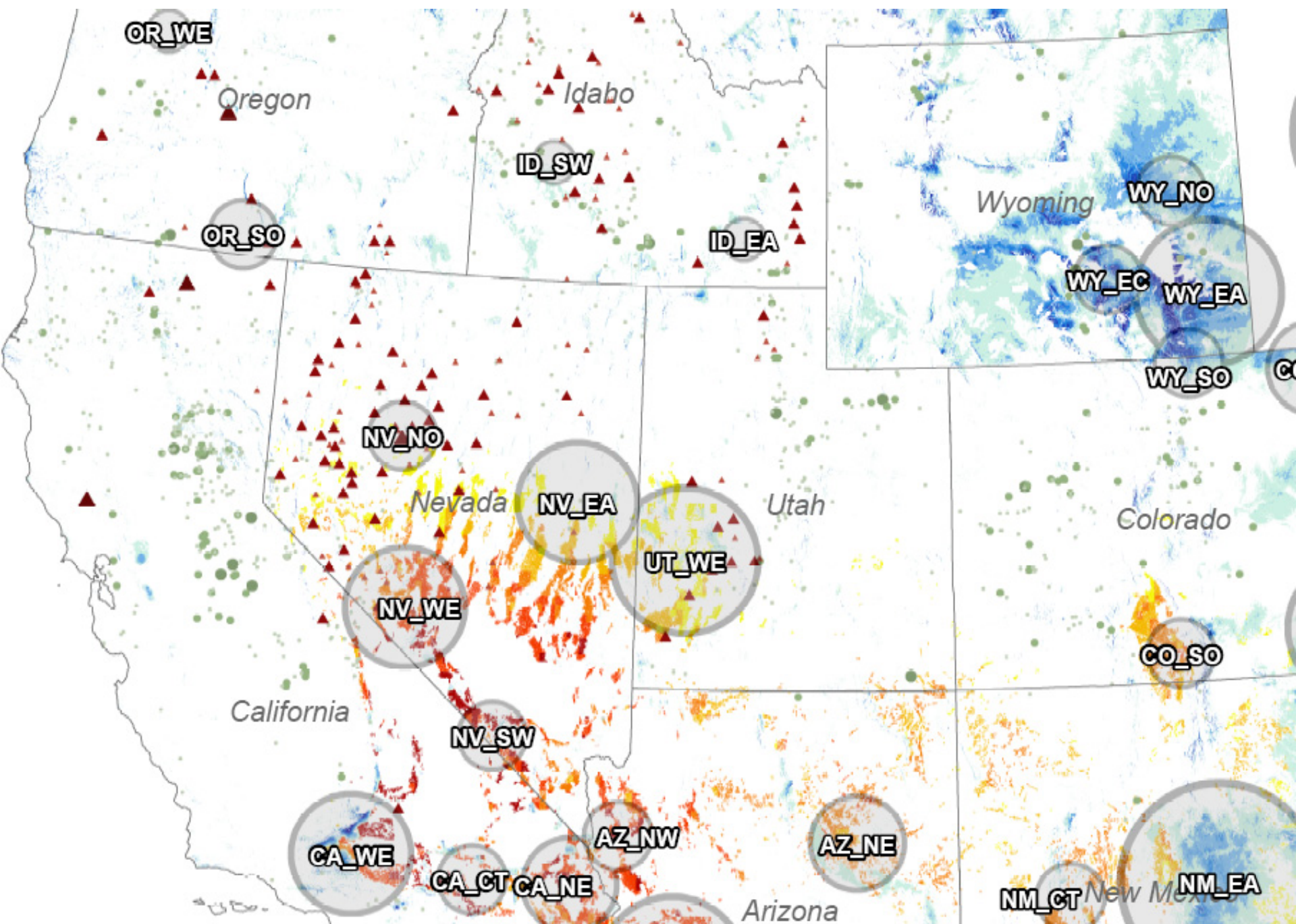
Wyoming: Hubs and resource concentrations are defined on a smaller scale than those in the continental United States. Wyoming's renewable resource potential is high, particularly in the north. However, the potential is not defined to suggest that renewable development should occur there. Wyoming's renewable resource potential is high, particularly in the north. However, the potential is not defined to suggest that renewable development should occur there.

and MT due to the abundance of high-quality wind resources in these states. In other states where the wind quality is generally lower, the thresholds are also lower.

Resources that do not meet the state-by-state or general quality thresholds are quantified in the WREZ report as part of the "non-WREZ" resource analysis. These include low quality wind and solar thermal, solar PV, undiscovered conventional geothermal potential, enhanced geothermal systems potential and all other viable renewable resources.

The assessment of conventional geothermal resources is limited to BC, CA, ID, NV, OR and UT due to the known high potential of conventional geothermal resources in these states. Biomass resources are quantified as part of the WREZ supply curve analysis for each QRA, although these resources are not shown on this map. The US hydropower resource assessment is preliminary and based on data that have not been validated or may be out of date. Therefore, both the location and the generating potential of US hydropower resources shown on this map are highly uncertain. Hydropower resource potential is not quantified in Alberta with the exception of one very large potential project in the north because data on the resource potential in the rest of the province are not publicly available.





Extended Analysis of WECC Resources

- Participate in Out of State (OOS) workgroup meetings.
- Perform detailed assessment of Baja wind capacity
- Consider substitution of WREZ OOS results for RETI in Oregon, Washington, Arizona, Nevada, and British Columbia
- Consider addition of additional states to RETI analysis from WREZ data set (e.g. include Wyoming and Idaho)
- Evaluate possibility to merge some OOS resource areas into adjacent CA CREZs (e.g., southern NV into Mountain Pass)
- Update transmission costs for out of state resources

Economic Model Update

- Consider incentives from the American Recovery and Reinvestment Act of 2009
 - Update Canadian/Mexican incentives
- Recalculate base economic rankings
- Re-perform uncertainty analysis
- Reformat model to be user friendly similar to the WREZ model (probably long-term)